ASSESSMENT OF THE APPLICATION OF CONTINGENT VALUATION THEORY TO BIO-SEQUESTERED CARBON

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ABSTRACT

The issue of carbon sequestration rights has become topical following the United Nations Convention on Climate Change (United Nations 1992 at page 1414) and the subsequent Kyoto Protocol (United Nations Climate Change Secretariat 1998) which identified emissions trading as one of the mechanisms to reduce greenhouse gas emissions. Australian states have responded by creating a legal framework for the recognition of rights to bio-sequestered carbon. There is a lack of uniformity in the approach of each state to the recognition of these rights, which vary from the creation of new and novel interests in land to the adoption of more traditional rights such as a *profit a prendre*.

Rights to bio-sequestered carbon are likely to have an impact on the utility, marketability, value and financing of rural land holdings. Despite the creation of the legal framework for recognition of rights to sequestrated carbon, there has been a delay in the introduction of a formalised carbon trading scheme in Australia. In the absence of an established carbon market, this paper addresses the applicability of contingent valuation theory to assess the value of bio-sequestered carbon rights to a rural land holder. Limitations and potential controversies associated with this application of contingent valuation theory are also addressed in this paper.

Key words: carbon sequestration, contingent valuation theory, rural land

INTRODUCTION

The issue of carbon sequestration rights has become topical following the United Nations Convention on Climate Change (United Nations 1992) and the subsequent Kyoto Protocol (United Nations Climate Change Secretariat 1998) which identified emissions trading as one of the mechanisms to reduce greenhouse gas emissions. Australian states have responded by creating a legal framework for the recognition of rights to bio-sequestered carbon. The term bio-sequestered carbon is the carbon that is stored in trees, plants, soils and oceans. For the purposes of this paper bio-sequestered carbon is limited to the carbon stored in forestry.

Although the legal structure to protect rights to sequestered carbon is in place in Australia there is not an established market for carbon rights. It seems likely that the rights to bio-sequestered carbon will have a long term impact on the utility, marketability, value and financing of rural land holdings due to the nature of the *profit a prendre* registered interest in the land. When considering the impact of rights to sequestered carbon on land holders it is helpful to consider the value of these rights in the absence of an established carbon trading market. Rural land holders can use this information as part of a cost benefit analysis in land use planning.

Contingent valuation theory has been used as an economic analysis tool to ascertain the value of goods in numeric terms in the absence of an established market. It has been applied to value many goods that are not traded in a market including natural resources, healthcare initiatives and infrastructure. However, there is limited academic attention to the application of the contingent valuation method to sequestered carbon rights. By way of contrast there has been substantial academic discussion on the topic of contingent valuation with rigorous debate for and against this method of economic analysis. This paper captures some of the academic discussion surrounding contingent valuation theory, including the limitations of the approach and considers the applicability of contingent valuation theory to assess the value of bio-sequestered carbon rights to a rural land holder.

This paper is structured as follows. Firstly there is an explanation of the problem surrounding rights to sequestered carbon and why this is an issue worthy of further academic attention. Contingent valuation theory is then discussed as a method of valuing rights to sequestered carbon in the absence of an established market for these rights. The pitfalls and limitations of the method are then addressed which is followed by a discussion of the applicability of the contingent valuation method to value rights to sequestered carbon. Conclusions are then drawn and areas for further research are identified.

This paper serves as an initial review of the contingent valuation method and the applicability of the method to assess the value of sequestered carbon to a rural land holder. This paper is the first stage of a more detailed research project. The second

stage will be the application of contingent valuation method to assigning a value to rights to sequestered carbon.

SEQUESTERED CARBON: THE NATURE OF THE LEGAL INTEREST

Carbon rights are an important element of an Emissions Trading Scheme which was originally to be introduced in 2010 in Australia and is still proposed for future introduction. As part of the emissions trading scheme it is likely that firms covered by the scheme will be able to purchase carbon forestry rights to offset their carbon emissions. The establishment of Carbon trading rights as tradable property rights was accepted as an immediate priority both in Australia and internationally (Prime Ministerial Task Force on Emissions Trading 2007).

In addition to the complexity surrounding an emissions trading scheme is the complex issue of how carbon is sequestered in soil and plants. The ownership of rights to sequestered carbon is an issue when reconciled with the system of land tenure and ownership in Queensland for freehold land and state leasehold land. It has been suggested that the use of a *profit a prendre* as a registrable interest in land would apply to the ownership of sequestered carbon rights to vegetation.

This research seeks to assess the impact that rights to sequestered carbon will have on rural land holdings where there is a fracturing of ownership between the rights to the carbon in vegetation and the ownership of the land itself. This situation is fundamentally at odds with the established common law position that the owner of an estate in fee simple has absolute rights to the ownership of all vegetation growing on the land.

The position in Australia is in contrast to the situation in Europe where the regulatory framework for an emissions trading scheme does not include rights to sequestered carbon. A limited emissions trading framework has been established by the European Union with a view to building up expertise. Carbon forestry rights are not able to be traded on the European Emissions Trading Scheme until some time in the future.

The area of carbon rights as a property right has become a topic of interest for academic writers such as Hepburn and Reich (2009), Boydell (2009) and Takacs (2009). Discussion has commenced as to how these rights should be classified within the existing rights framework. Hepburn (2009) reviews the legislative approaches adopted by each state and territory in Australia for addressing the issue of carbon rights and separating the incorporeal nature of rights to sequestered carbon from those more tangible rights that flow from land ownership.

The fragmentation of property rights to include rights to sequestered carbon as a proprietary right is essential to any proposed carbon trading scheme to be introduced

in Australia, where carbon rights are traded as carbon offsets. Hepburn and Reich (2009) refers to a carbon right as a new statutory right which is unique and confers upon the holder of the right an incorporeal benefit to carbon sequestered within forestry planted on the land. Accordingly the treatment of a carbon right as a *sui generis* right is preferable to preconceived common law categories of property rights such as a *profit a prendre* adopted by some jurisdictions in Australia, such as Queensland and New South Wales.

Internationally there is significant variation between the level of resolution and appropriateness regarding carbon as a property right. To add to the complexity of this situation in some areas of high forestation there is not an established land tenure system, such as the Amazon in Brazil. Further some international jurisdictions, such as Indonesia seem to be in a state of flux where demarcation between various levels of government and sub-government, property rights and responsibilities and the economic benefits of a carbon framework are not clear (Takacs 2009). It is noted by Takacs (2009) that central to the success of any forest carbon project is the clear articulation of title to carbon and property rights in addition to the enforceability of those rights.

The legal framework for the recognition and protection of carbon rights in Australia is varied due to the separation of powers between each of the states and territories and the Commonwealth by virtue of Section 51 of *The Commonwealth of Australia Constitution Act 1901*. Although the Commonwealth does have some powers to make laws pertaining to the environment by virtue of the external affairs power in section 51(xxix) of the Constitution as established through the Tasmanian Dam case (*Commonwealth v Tasmania(1983)*), land management and forestry are not Commonwealth powers and consequently fall within the gambit of the states and territories. For this reason the treatment of carbon rights varies significantly across the states and territories. However, there is an argument that legislation that creates a proprietary interest in land in the form of carbon rights should be uniform nationally to prevent confusion for those seeking to trade in carbon rights. Arguably, the system as it exists will also create varying levels of security of investment across the states for those seeking to invest in carbon rights.

In addition, the impact of carbon sequestration trading on the agricultural sector has been considered by many academic writers such as Marland, McCarl and Schneider (2001), Antle and Mooney (1999), Lal, Kimble, Follet and Cole (1998) and Metting, Smith and Amthor (2001). However, much of this work has been undertaken from a scientific perspective as to the effectiveness of sequestration of carbon in soil and the impact of changes in land use, especially the forestation of agricultural land. However, the impact of carbon trading in on the utility of Australian rural land and the value of Australian rural land has received very limited attention. An understanding of the value as well as the nature of legal rights to sequestered carbon would be useful in future analysis.

THE CONTINGENT VALUATION METHOD

Contingent valuation was first proposed in 1947 by Ciriacy-Wantrup (1947) who thought that the prevention of soil erosion was of greater public value and to ascertain the value of such public goods was to elicit the individuals willingness to pay for these benefits through a survey method. The method was first used empirically by Davis in 1963 when he estimated the value of the benefits of goose hunting through a survey of goose hunters (Venkatachalam 2004) and has continued to develop alongside econometric modelling over the past 50 years.

The decision as to whether to commit to a certain policy or project, such as a carbon forestry project, is frequently based on economic analysis or cost benefit analysis whereby the benefit of a project or policy implementation is balanced against the costs of the project. The benefits and costs are frequently estimated in economic terms or a dollar value. This method of analysis is flawed when the benefit is not something that is bought and sold in the market or where there is not yet an established market. Contingent valuation is a survey based method which is used to place a numerical value on goods and services which are not bought and sold in the market place. This method is frequently used to place a value on environmental goods or services where there is no established market or when accurate cost or sale information is not available. Contingent valuation method is used to assist in the decision making process for the implementation of goods or services in the absence of an established market.

A variety of tools have been developed to place a value on goods that do not have an established market so that they can be compared with goods that do have a market established value. According to Carson (2000) the approaches used are either based on either the observed behaviours in relation to marketed goods that are connected with the non-marketed goods or to stated preferences in surveys with respect to the non-marketed good. Contingent valuation falls in the second group of stated preferences.

The approach is commonly used to estimate an individuals' willingness to pay for environmental resources as part of environmental impact assessments, transport infrastructure, health economics and cultural economics. This method has also been used in developing economies to assess the individuals' preferences for basic infrastructure projects such as water and sanitation (Venkatachalam 2004). Even as early as 1994 Hanemann (1994) noted that there were over 1600 contingent valuation studies that have been undertaken in over 40 countries on a wide variety of topics.

Contingent valuation is based upon constructed scenarios that offer different possible future alternatives. The survey respondents are then instructed to state their preferences to those alternatives. The choices made by the survey respondents are analysed against the choices made by consumers in market transactions. In effect the survey creates a hypothetical market from which an actual market value is derived. As the name suggests values that are received by respondents are contingent upon the constructed hypothetical market which is presented in the survey (Portney 1994).

There appears to be no one way that a contingent valuation study is implemented. According to Carson (2000) the contingent valuation approach in its simplest form would involve the respondent making a binary choice between two alternatives, one being the current status quo and the other being the alternative policy/program which has a cost greater than maintaining the status quo. In this scenario the respondent will provide a favour or not in favour response to the policy/program where the implementation, cost and alternatives to the policy have been specified. When the costs numbers are randomly supplied to respondents the researcher is able to trace out the distribution willingness to pay (WTP).

Willingness to pay is a standard measure of economic value. The other may be minimum willingness to accept (WTA) which is used in the context where the respondent is being asked to voluntarily give up a good or the utility of the good. Carson (2000) draws the distinction as to when each of these measures is used according to whether the right to the property in the good is currently held by the respondent. If the respondent does not have a legal entitlement or right to the good then WTP would be the appropriate measure. However, if the respondent does have legal entitlement then WTA would be the appropriate measure to assess the compensation for its loss.

The WTP and WTA could be used interchangeably to assess an individual's preferences for change in policy or service. Venkachalam (2004) uses the example of a change in environmental policy that would result in improved air quality to a particular locality. An individual resident in the locality could be asked either their maximum willingness to pay for a change that would bring about improved air quality in the region or their willing to accept compensation for the diminution in air quality that would result if the proposed policy change is not implemented.

CRITICISMS OF THE CONTINGENT VALUATION METHOD

Contingent valuation studies have come under a great deal of academic scrutiny and review by government and lobby groups. However, it was not until the 1980's that high profile litigation meant that the method was under review by the American courts. However in the case of *State of Ohio v US Dept of the Interior* support was

articulated for the application of the contingent valuation method. It was stated that '*We see nothing arbitrary or irrational about the rebuttable presumption conferred upon natural resource assessments, including those utilizing CV methodology. On the contrary, the procedures preconditioning damage assessments support the logic of the presumption...'*(1989)

Academic debate surrounding the contingent valuation method has included a discussion as to whether passive-use or existence values should be taken in account in economic analysis (Carson 2000). Generally economists are of the opinion that marketed goods have a value derived from their utility or the ability of the consumer to physically use the goods or have some physical connection with the goods. The notion of passive-use is central to contingent valuation. Through passive-use it is possible to get utility from a good without actually using it. Passive use value is also referred to as existence value. This is the value that individuals may place on natural environments for merely knowing that rare and unique fauna and flora exist without even ever visiting them (Portney 1994). The notion of passive use or existence value is central to the application of contingent valuation to environmental resources. In the absence of passive-use considerations assets that are purely for public good such as national parks would have no value what so ever.

According to Carson (2000), if passive-use considerations were not included for items which are for the pure public good then they would have little or no economic value. Items for the pure public good include things like the overall level of air quality, national defence and remote wilderness areas. Carson further defines pure public good as those for which 'it is impossible to exclude people from enjoying the good and from which enjoyment by one person does not degrade another person's enjoyment of the good' (Carson 2000at page 1414). Pure public goods can not be measured by traditional economic techniques because there is no link with consumption of the goods in different quantities at different prices.

Criticisms of contingent valuation also stem from the technical elements of the approach. This is usually concerning either the validity or reliability of the contingent valuation method (Venkatachalam 2004). An issue that also requires attention in the contingent valuation method is the disparity that frequently exists between the WTP and WTA for the same good (Venkatachalam 2004). Frequently the WTA measure creates a much higher value than the WTP. This disparity is thought to be due to the 'income effect'. That is that the WTP is constrained by income whereas the WTA is under no such constraint. Shogren (1994 as noted in Venkatachalam 2004) demonstrated that the divergence between WTP and WTA disappears for two private goods with repeated trials whereas for public goods the divergence is generally maintained. The question then arises as to which measure is more appropriate to valuing non-market goods.

A contingent valuation study estimate of value will generally be one of total economic value which includes WTP or WTA and will include both direct-use and passive use considerations. It may be problematic to disaggregate these two components.

Many of the criticisms of contingent valuation are merely due to the fact that it is a survey based method. Generally surveys have been criticised for being too vulnerable to response effects, i.e., small variations in the wording of the survey questions can cause significant changes in the survey responses. All surveys are vulnerable to this phenomena and the researcher's response is generally to detect discrepancies in the survey and correct them. Beyond this all survey responses will contain a percentage of response effects.

Hanemann (1994) identified that one issue that could be criticised in the contingent valuation approach is that the survey itself creates the value for the item and that the respondents themselves have not assessed a value. A respondent debriefing process (as suggested by the NOAA panel) will help to identify responses that have been ill-informed or ill-considered (Portney 1994). These responses can then be disregarded.

The contingent valuation method has also been criticised on the basis that the survey responses can not be verified. However, Hanemann (1994) notes that there are over 80 studies which offer a comparison between contingent valuation and indirect methods and the results are often fairly close.

DESIGN OF THE CONTINGENT VALUATION STUDY

As noted by Ciriacy-Wantrup (1947) surveys are not foolproof and the success contingent valuation method, as a survey based method, is largely due to the survey design. According to Portney (1994) although contingent valuation studies vary significantly virtually every application has some well defined elements:

1. A survey must contain a hypothetical or real policy or program that the respondent is being asked to respond to.

2. The survey must contain a mechanism for obtaining some kind of choice by the respondent. This can be through open-ended questions, bidding games, or referendum formats.

3. Contingent valuation surveys also elicit some information regarding the socioeconomic position of the respondent, their usual environmental preferences with a view to estimating their WTP and explaining variables in the survey.

A panel of experts chaired by Nobel laureates Kenneth Arrow and Robert Solow were asked to provide advice on the following question: is the contingent valuation method capable of providing estimates of lost non-use or existence values that are reliable enough to be used in natural resource damage assessments? (Portney 1994). In response to this question the panel concluded that 'contingent valuation studies [applications of the contingent valuation method] can produce estimates reliable enough to be the starting point of a judicial process of damage assessment, including lost passive use values' (Portney 1994 at page 8). The panel went on to provide further guidance on the application of the contingent valuation method and when it can be successfully relied upon for lost existence values for the purposes of damage assessment or regulation (Portney 1994).

1. Application of the contingent valuation method should rely on personal interviews rather than telephone interviews and telephone interviews would be considered more reliable than mail surveys.

2. Application of the contingent valuation method should elicit a WTP rather than a WTA although WTA would be more applicable to assess damages where an incident had already occurred.

3. There is a preference for closed-ended referendum style questions. The panel noted that individuals were often asked to make these kinds of real world choices.

4. Applications of contingent valuation should begin with a scenario that accurately describes the effects of the program that is under consideration.

5. Proponents are reminded that there is a finite source of money and showing a WTP would mean that they would have less money to allocate elsewhere.

6. Application of contingent valuation should include reminders to respondents of the substitutes for the commodity in question.

7. One or more follow up questions should be included to ensure that the respondents understood choices they were being asked to make and the reasons for their answer.

Although these guidelines specifically relate to an environmental policy decision they are transferable to other applications of contingent valuation method.

Some of these criticisms can be overcome by the design of the contingent valuation study. As with any survey based technique the strength of the study lies in good design. According to Hanemann (1994) the style of questioning changed around the 1980's. Until this time very open-ended questions were asked. The emphasis has moved to more closed-ended, referendum style questions, e.g. if this policy cost $x to implement would you be willing to vote for it. By plotting the number of positive responses against the dollar amount shows the cumulative distribution function of WTP (Hanemann 1994). This type of questioning is realistic as to the choices that consumers make routinely, i.e., an item is listed at a certain price and the consumer decides whether or not they will purchase that item. In addition to closed ended referendum style questions Cameron & Quiggin (1994) advocate a 'double bounded' referendum approach. This method was first proposed by Carson, Hanemann & Mitchell (Cameron and James 1987) and overcomes an identified problem with dichotomous choice valuation questions in that larger numbers of observations are required to identify the underlying distribution of resource numbers or WTP with any accuracy. In this approach the respondents are asked follow up dichotomous choice questions to elicit a second response. For example, if a respondent indicates a WTP at a certain value then the follow up question would seek a response to a WTP at double the stated value. Conversely, if a respondent did not indicate a WTP at a stated value then the follow up question would halve this value.

Portney as discussed by Hanemann (1994) identifies other ways to make the survey questionnaire more reliable. He suggests 'providing adequate and accurate information; making the survey balanced and impartial; insulating it from any general dislike of big business; reminding respondents of the availability of substitutes, and of their budget constraint; facilitating "don't know" responses; allowing respondents to reconsider at the end of the interview.' (Hanemann 1994 at page 24). Hanemann also suggests that steps should be taken to eliminate the perception of interviewer pressure. This can be done by explaining that there are no right answers and explaining some of the reasons why respondents may vote against. Alternatively, it may be that the interviewer doesn't actually see the respondents answers which may be deposited in a ballot box. The NOAA Panel also suggest a debriefing to check the respondents' understanding to the key elements of the contingent valuation scenario (Portney 1994).

Analysis of the survey data will also influence the outcome of the study. Hanemann (1994) suggests that the mean in an unreliable measure because it is sensitive to the right tail of the distribution whereas the median is more robust. Further, Hanemann (1994) comments that if the mean is used then a nonparametric or bounded influence approach is recommended for fitting the WTP distribution.

CONTINGENT VALUATION TO VALUE RIGHTS TO SEQUESTERED CARBON

The contingent valuation method has been successfully applied to a variety of international contexts. In Australia, the contingent valuation method has been applied to issues such as assessing land use options and competing interests. A contingent valuation study was done of the Kakadu region in northern Australia. Kakadu is an extremely important wilderness area which also has substantial mineral deposits including uranium and gold. When the study was commissioned by the Australian Government a substantial portion of the area had already been declared a National Park with the area under contention being proposed for a gold and uranium mine, 'Coronation Hill'. The contingent valuation study was used to provide policy input for a decision on the outcome of this land to be determined.

The commonality of most contingent valuation studies is that a value is being placed on a good or service that is generally supplied by government with a high degree of passive use or existence value. There is either an opportunity cost to maintaining the public use good or area or there is a cost of implementation with a positive public outcome. Similarly, rights to carbon sequestered in forestry are held for the greater public good with a view to satisfying Australia's obligations under the *Kyoto Protocol*. Rural land holders will suffer an opportunity cost in having land allocated to carbon storage through forestry as opposed to agricultural production. The contingent valuation method will have application to determine the value of rights to sequestered carbon in the absence of an established carbon market.

CONCLUSION

The contingent valuation method is a popular and well used method for assigning a value to a good or service that is not bought and sold in the market place. Although there has been some criticism of the contingent valuation method by lobby groups, government and academics there is also a great deal of support for the method in the academic community. The contingent valuation method appears to be particularly useful for determining passive use or existence values.

Like any survey based method the reliability of the outcomes is largely dependent on the survey instrument itself. The academic debate concerning the contingent valuation method over the past 40 years has provided a great deal of guidance as to the construction and implementation of a contingent valuation study.

The area of rights to sequestered carbon would be suitable for the application of a contingent valuation study in that there is not an established marketplace for these rights. Due to the nature of rights to sequestered carbon in forestry they come at an opportunity cost to the land holder who is not able to assign the land to more traditional agricultural uses. This is an area identified as worthy of further academic consideration.

It has been established that a contingent valuation study would be an appropriate method to value rights to sequestered carbon in forestry in the absence of an established market. To progress this study further the researchers propose to develop and administer a survey instrument to establish the perceived value of these carbon rights.

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